

ST535 Temperature Programmer User Handbook



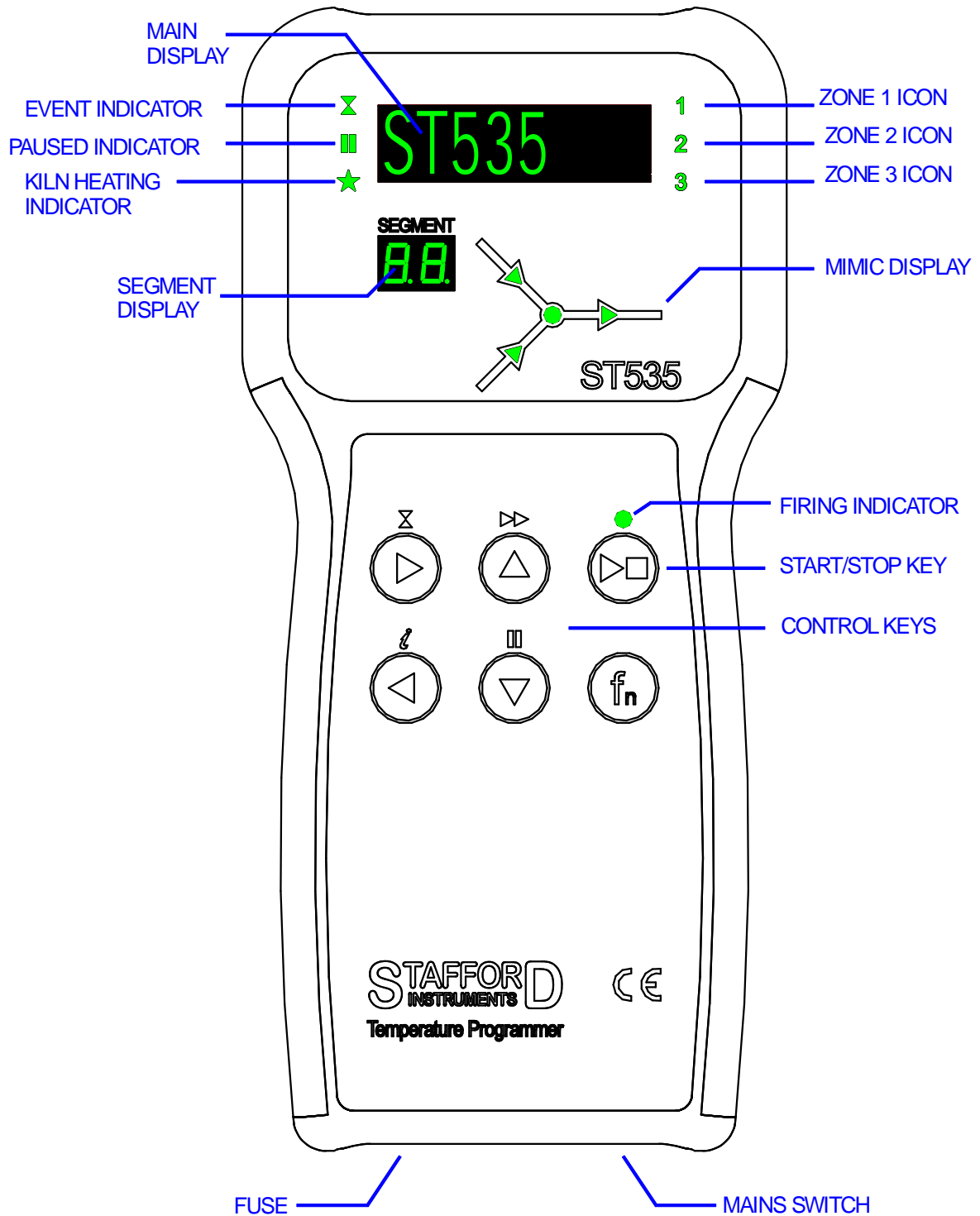
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See separate handbook for Installation Instructions
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At a Glance



Quick Start Guide

Switch on & wait for kiln temperature display

To run a firing program set up previously press the **■** key

To stop the firing at any time press the **■** key again

To review firing data press the **■** key to enter the programming mode

To change firing data press the **■** & **■** keys to change the displayed value

Use the **■** key again as necessary to step to the next firing value or segment to be reviewed or changed

To mark the end of a program set a ramp rate to END with the **■** key

To exit the programming mode either wait 20 seconds or press the **■** key to start firing

If the keyboard is locked then press and hold down the **fn** key for 5 seconds to unlock

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Features

- Multi-zone (1,2 or 3 zones)
- 32 programs each with 32 segments
- 1 controlled heating / cooling ramp + soak per segment
- Soak periods up to 99 hours 59 mins
- Ramp rates from 0.1 to 999°/hour + FULL
- Ideal for glass or ceramics use
- Programs can be altered while firing
- Program pause and advance facilities
- Keyboard lockable
- Delayed start facility - up to 99 hours 59 mins
- Power failure recovery
- Energy used display
- Setpoint display
- Alarm buzzer & alarm relay output
- Programmable event / damper / fan relay output
- Mains power switch
- °C/°F operation

Turning On



- 1 When turned on the ST535 performs a display test by lighting all of the display segments and illuminating all of the front panel indicator
- 2
- 3 lamps.



- 1 The version number of the software embedded within the ST535 is now displayed. If you need technical support you might be asked for this code together with the serial number.
- 2
- 3



- 1 Next displayed is the thermocouple type setting. This should match the type of thermocouple fitted to the kiln and can be R, S, K or N type (R,S,K,N).
- 2
- 3




- 1 The final display will show the kiln temperature. All other lamps should be off.
- 2
- 3



- 1 If pressing any key causes LOCKED to appear then the keyboard has been locked. This is an anti-tamper feature. Press the **fn** key & hold down for 5 seconds to unlock.
- 2
- 3

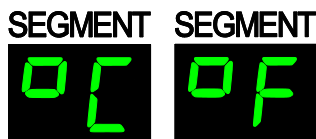


- 1 This now shows that the keyboard is UNLOCKED. To re-lock the keyboard press the **fn** key & hold down for 5 seconds.
- 2
- 3

If any mimic panel lamps are on then the ST535 is firing. To stop the firing press the  key.



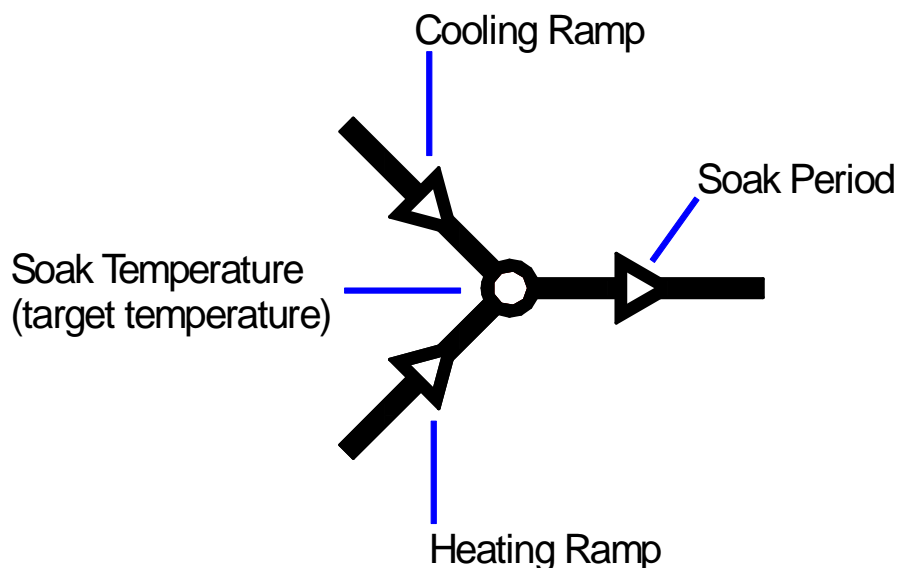
- 1 During firing the star icon will light to show when heating power is being applied to the kiln.
- 2
- 3



Note: During power up the SEGMENT display shows the operating units (°C/°F) of the ST535 (Installer adjustable).

Programming

A firing segment



An ST535 firing segment comprises a ramp followed by a soak period. Two segments can be used for simple firing (biscuit firing for example) or several segments can be used per program for complex firing (crystal glazing or glass-making for example).

The ST535 ramps the kiln temperature at the required ramp rate until the kiln reaches the soak / target temperature. It then soaks (dwells) at the soak temperature for the soak period. It then runs the next segment until the end of the program is reached.

The ST535 is capable of both positive (heating) ramps and negative (cooling) ramps - as used in glassmaking for annealing. The type of ramp is clearly shown on the mimic display during firing.

The ramp rate is settable in the range 0.1 to 9.9°/hour then 10 to 999°/hour or FULL (full power) or END (end of program).

The soak / target temperature is settable over the range 0 to 1400°C (2552°F).

The soak period is settable over the range 00.00 (no soak) to 99 hours 59 mins.

Note: during soaking the ST535 display alternates every 15 seconds between kiln temperature and soak period remaining.

Altering a program



20°C

- 1 When not firing there are no indicators lit on the mimic panel, the run indicator is off and the display shows the current kiln temperature.
- 2
- 3

The controller settings can be reviewed by pressing the key.



PROG: 1

- 1 The first push of the key flashes the program number display. The required firing program can now be selected with the & keys.
- 2
- 3

Note: holding down the or keys causes rapid change of the displayed value.



150°C/HR

- 1 The next push of the key displays the ramp rate in the range END, 0.1-9.9°/HR, 10-999°/HR or FULL. This can be altered with the & keys. The heating ramp or the cooling ramp
- 2
- 3

indicator on the mimic panel will flash. END marks the end of the program. FULL heats or cools as fast as possible.



600°C

- 1 The next push of the key displays the soak temperature. This can be altered with the & keys. The soak temperature
- 2
- 3

indicator on the mimic panel will flash.

- 1 The next push of the key displays the soak period in hours:minutes. This can be altered in the range 00:00 to 99:59 with the & keys. The soak period indicator on
- 2
- 3

the mimic panel will flash.

SEGMENT The next push of the key increments the segment number digit and firing data for the next segment can be entered.

2



END

- 1 Program data entry is terminated if END is selected for a ramp rate with the key.
- 2 Program data entry is also automatically
- 3 terminated if the maximum number of seg-

ments have been entered.

Note 1: available ramp rate displays are: END, 0.1 ... 999 & FULL. If END is shown but another segment is required then push the key to obtain the required ramp rate (in the range 0.1°/hr to 999°/hr). If full power is required then push the key until FULL is displayed. To mark the end of the program push the key until END is displayed

Note 2: to exit programming without cycling through all of the above steps wait 20 seconds without pressing any keys - the ST535 will revert to the idle display. Alternatively press the key to exit programming and to begin firing immediately.

Note 3: the key can be used to reverse through the programming steps to correct errors or to exit programming mode.

Temperature Display

This section only applies to multi-zone (2 or 3 zones) kilns. A single zone kiln will always show the temperature of zone 1 only.



1 For a single zone kiln the zone icons are not used and the temperature of zone 1 is always displayed.

2

3



1 For multi-zone kilns the temperature of each zone can be displayed. Zone 1 is displayed by default when the ST325 is powered on.

2

3



1 To change the displayed zone press either the
or keys. The zone number icons will
2 change to show which zone temperature is being displayed.

3

Firing

To start a firing press the **■** key. The firing indicator lamp will flash.



- 1 With the firing indicator flashing an optional start delay up to 99 hours: 59 minutes can be entered with the **▶** & **■** keys.
- 2
- 3

After 10 seconds, or immediately if the **■** key is pressed again, the firing will commence and the firing indicator lamp will remain lit.

To stop the firing prematurely at any time press the **■** key again. The firing indicator lamp will go out.

Hint: it is good practice to check that the program is correct by pressing the **▶** key & checking the program number & program contents before pressing the **▶** **■** key to start a firing. It is also a good idea to have a written record of the contents of the firing programs kept and displayed near the kiln especially if there is more than one user of the kiln.

Note: during ramping the ST535 will perform either controlled heating or controlled cooling - as indicated on the mimic display. During soaking the ST535 display alternates every 15 seconds between kiln temperature and soak period remaining. At the end of each segment the segment number display will be incremented.

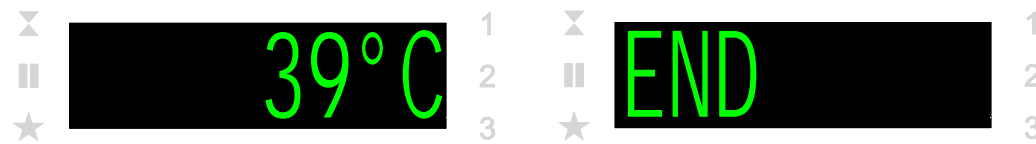
Information: The ST535 operates by calculating the amount of energy required by the kiln every 30 seconds (installer adjustable). If for example 40% of full energy is required to maintain a particular ramp rate or a particular soak temperature then the ST535 will apply heating power to the kiln for 12 seconds every 30 seconds. The kiln heating indicator will light for 12 seconds every 30 seconds. If the kiln has a contactor then a loud click will be heard both when the kiln heating indicator lights up and when it goes out. If full heating power is required then the kiln heating indicator will remain lit. If full cooling is required the kiln heating indicator will remain off.

Cooling

Upon completion of firing the ST535 lights all lamps on the mimic display and the kiln is allowed to cool naturally.



While the kiln temperature is above 40°C the display alternates every 5 seconds between the kiln temperature and HOT.



When the kiln has cooled to less than 40°C the display alternates every 5 seconds between the kiln temperature and END.

To return the ST535 back to idle condition ready for the next firing press the ■ key (or turn off the power to the instrument).

Operating Notes

Kiln too slow

If the ST535 is programmed to heat the kiln at a faster rate than the kiln is capable of then the ST535 will turn on full power then wait until the kiln temperature has risen to the correct temperature before proceeding to the next ramp or soak segment.

Likewise if the ST535 is programmed to cool the kiln at a faster rate than the kiln is capable of then the ST535 will apply zero power then wait until the kiln has cooled to the correct temperature before proceeding to the next ramp or soak segment.

Heating & Cooling Ramps

The ST535 is capable of controlled ramps for both heating and cooling. The type of ramp required is determined by comparing the required soak temperature to the soak temperature in the previous segment and is shown on the mimic display.

■ Key Operation

If the ■ key is pressed during a firing then the firing will be halted (not paused). Pressing the ■ key again will cause the ST535 to restart the firing from the beginning. The ST535 will look at the current kiln temperature and if this is greater than the required soak temperature then the ST535 will automatically *cool* from current temperature to the soak temperature. This may not be what is desired so the ■ key should only be used to halt the firing in an emergency.

The program can be paused or program data can be changed while the controller is firing. This is a better option than using the ■ key. The program advance feature is however available to recover quickly from ■ key operation if required (see %Adjusting While Firing+section).

Memory

All programs & necessary data are remembered when the ST535 is turned off. In the event of power failure during firing the ST535 will automatically resume firing when power is returned (this feature can be disabled: see installation handbook).

Delayed Start

By default the delayed start time period is initialised to 00:00 for each firing. The ST535 can however be configured to remember the delayed start time period (see Installation Handbook).

Adjusting While Firing

Firing values can be adjusted while the ST535 is firing. Also there are program pause and program advance features that are particularly useful for glass work.

Adjusting Firing Values

While firing operate the **FN** key to select the required parameter as shown by a flashing lamp on the mimic display. The firing value is shown on the main display and can now be adjusted with the **←** & **→** keys in the usual way. The contents of the current segment or any segment still to be executed can be changed. Firing will still carry on as normal while these changes are being made. The ST535 will return to its normal running display 20 seconds after key presses cease (or immediately after END is displayed).

Changes made to programs in this way are stored and are used for subsequent firings.

Program Advance Facility

While firing press and hold down the **fn** key then press the **▶** key to obtain the **▶▶** (advance) function. The ST535 will sound a short beep and the executing program will immediately advance one step as indicated by lamps on the mimic panel. The effect of this is as follows:-

If ramping then the ST535 will switch to soak at the current kiln temperature. If soaking then the ST535 will advance to the next segment if any, or else it will end the firing.

Changes made to the operation of the ST535 in this way are temporary and are not stored.

Program Pause Facility

While firing press and hold down the **fn** key then press the **⏸** key to obtain the **⏸** (pause) function. The ST535 will sound a short beep and the executing program will pause at the current kiln temperature. The pause indicator (**⏸**) will light. To release the pause repeat the above action.



PAUSED

- 1 While paused, the kiln temperature display will alternate periodically with a scrolling PAUSED display and a beep will be sounded.
- 2
- 3

WARNING - PROGRAM PAUSE

The program pause facility should be used with care. Program execution is suspended and the kiln will be held at its current temperature. If left too long at high temperatures kiln damage could result. Pause will automatically release after an Installer-defined time period (default: 2 hours - see Installation Handbook).

Error Messages

If the ST535 detects a problem the buzzer will sound and an error message will be displayed. This error message will alternate with a display of kiln temperature. The segment number display will show where the error occurred.

To obtain more information on the error operate the **key**. The first press will display the maximum temperature reached in the firing. The second press will display the length of time that the error has been present. The buzzer will mute.

✕ || ★ **ERROR: 1**

- 1 Heating error. The kiln temperature is not increasing as required. The kiln has been on full power for 1 hour but the temperature has not increased by at least 8°C.
- 2
- 3

Possible causes: kiln door or lid not closed properly or door switch faulty or needs adjusting. Heater element open circuit or elements too old. Electrical power phase failure or contactor failure.

✕ || ★ **ERROR: 2**

- 1 Thermocouple or thermocouple wiring open circuit. Get thermocouple and wiring checked.
- 2 Replace thermocouple if necessary.
- 3

✕ || ★ **ERROR: 3**

- 1 Thermocouple reversed (kiln temperature apparently less than -40°C). This is an installation fault. Get wiring checked.
- 2
- 3

✕ || ★ **ERROR: 4**

- 1 Cooling error. The kiln has been on zero power for 30 minutes but the kiln temperature has not fallen by at least 1°C.
- 2
- 3

Possible causes: contactor failure (contacts welded?) or thermocouple connection intermittent or high resistance.

✕ || ★ **ERROR: 5**

- 1 Kiln temperature overshoot. The kiln temperature exceeds the desired temperature by a pre-set limit.
- 2
- 3

✕ || ★ **ERROR: 6**

- 1 Maximum firing time exceeded. The length of the firing has exceeded an installer selectable limit.
- 2
- 3

✕ || ★ **ERROR: 7**

- 1 Maximum room temperature exceeded. The internal temperature of the ST535 has exceeded an installer selectable limit.
- 2
- 3

Possible causes: kiln room vent fan failure, kiln room too small, ventilation grills blocked, damper or bung left open, controller mounted too close to kiln.



ERROR: 8

- 1 Internal data conversion circuit (ADC) error.
- 2
- 3



ERROR: 9

- 1 Maximum allowable differential temperature between zones exceeded. The temperature of zone 2 or zone 3 has varied from zone 1 by an installer selectable limit.
- 2
- 3

All these error messages cause the ST535 to terminate the firing. The alarm buzzer will sound once per second. To reset the ST535 turn off the power to the instrument and have the fault investigated and rectified by your installer or kiln service engineer.


Note: these error messages are provided to detect kiln faults and so offer some protection to the kiln.



Technical note: these error messages will cause the alarm relay to open.

Firing Program Errors




ERROR: P

- 1 Program Error. This error message is displayed if a potential error is detected within the firing program when the  key is pressed to start a firing. The alarm buzzer will sound 3 times and the segment display will show the suspect segment number.
- 2
- 3

To clear this error press the  key. The ST535 will now enter programming mode to allow the suspect program to be viewed and altered if necessary. If a fault is found then correct it. If no fault is found then press the  key again to force the firing program to start. A potential programming error is defined as a very low ramp rate to a very low temperature. Such a programming fault might cause very long firing times with potential kiln damage.

Other Features

Energy Used & Setpoint Displays

- ✕  1 Press and hold down the **fn** key then press
|| 2 the **key** at any time to show the amount
★ 3 of electrical energy used in kWh. During a
firing the energy used so far is shown.

After a firing the total energy used for the firing is shown. This information is stored while power is off and is only reset to zero when a new firing is started. If the value displayed is always 0.0 then the kiln power rating has not been configured - see installation handbook.

Operating the **key** a second time shows the current set-point (the temperature which the ST535 is currently trying to achieve).

Keyboard Lock Facility

The keys on the ST535 can be locked so that pressing them has no effect. This is an anti-tamper feature used to ensure that the operation of the ST535 or the program data cannot be altered by un-authorized people. The ST535 can be locked when it is idle (not firing) or while it is firing. It cannot be locked while it is being programmed.

- ✕  1 Press and hold the **fn** key down for 5
|| 2 seconds to lock or to unlock.
★ 3

Power Failure Recovery

If power fails during firing then the ST535 recovers as follows:-
For power failure during start delay the ST535 times off the remaining start delay when power returns. For power failure during ramping the ST535 continues the ramp it was previously executing. For power failure during soaking the ST535 ramps back up to soak temperature at the correct ramp rate then applies the remaining soak period. This recovery scheme can be disabled if required (see installation handbook) - the ST535 will then lock up with FAIL displayed and kiln off in the event of power failure.

Control Relay

Control Relay Configuration

The ST535 has a relay output that can be configured (see installation instructions) as an event output, a damper control output, a fan control output or not used.

Event Output

The event relay can be programmed to change state at the start of a ramp and also at the start of a soak period. Thus both ramp and soak events are possible. The event output is ON (relay contacts are closed) when the event icon is lit. Prior to running a program the event output is OFF (relay contacts are open). The event output status is stored with the firing program.



150°C/HR



- 1 While displaying a ramp rate the event output can be switched on or off by holding in the **fn** key then pressing the (event) key. The event output will be ON when the event lamp is on.
- 2
- 3





























00:15

- 1 While displaying a soak period the event relay can be switched on or off by holding in the **fn** key then pressing the (event) key. The event output will be ON when the event lamp is on.
- 2
- 3

Damper Output

To enter the damper temperature configuration menu press the  key and the  key down together while the controller is not running a program (firing indicator not lit).

Note: in the sequence below if no key presses are detected within 30 seconds the ST535 will exit the menu and damper temperature changes will not be saved.

- | | | |
|---|---|---|
| 

 |  | 1 The damper close temperature prompt is shown. Release the  &  keys.
2 Press the  key.
3 |
| 

 |  | 1 The damper close temperature is now shown. Adjust with the  &  keys (hold down for acceleration).
2
3 Press the  key. |
| 

 |  | 1 The damper open temperature prompt is now shown.
2 Press the  key.
3 |
| 

 |  | 1 The damper open temperature is now shown. Adjust with the  &  keys (hold down for acceleration)
2
3 Press the  key. |

The instrument will now reset and the new damper control temperatures will be stored.

Note: in the sequence above it is important that the  key is pressed a total of 4 times else changes will not be saved.

Damper Operation

Prior to firing the damper will be open. During firing, when the kiln reaches the damper close temperature, the damper will close. The event indicator will be on.


At the end of the firing and when the kiln has cooled naturally to the damper open temperature, the damper will open. The event indicator will be off.


Fan Output


To enter the fan temperature configuration menu press the \blacktriangleleft key and the \blacktriangleright key down together while the controller is not running a program (firing indicator not lit).


Note: in the sequence below if no key presses are detected within 30 seconds the ST535 will exit the menu and fan temperature changes will not be saved.

- | | | |
|--------------|---|---|
| ✕

★ |  | 1 The fan start temperature prompt is shown. Release the \blacktriangleright & \blacktriangleleft keys.
2 Press the \blacktriangleright key.
3 |
| ✕

★ |  | 1 The fan start temperature is now shown. Adjust with the \blacktriangleup & \blacktriangledown keys (hold down for acceleration).
2
3 Press the \blacktriangleright key. |
| ✕

★ |  | 1 The fan stop temperature prompt is now shown.
2 Press the \blacktriangleright key.
3 |
| ✕

★ |  | 1 The fan stop temperature is now shown. Adjust with the \blacktriangleup & \blacktriangledown keys (hold down for acceleration)
2
3 Press the \blacktriangleright key. |

The instrument will now reset and the new fan control temperatures will be stored.

Note: in the sequence above it is important that the \blacktriangleright key is pressed a total of 4 times else changes will not be saved.

Fan Operation

Prior to firing the fan will be off. During firing the fan will start when the kiln temperature has risen to the fan start temperature.

The fan will remain on until the kiln temperature has risen to the fan stop temperature. The fan then turns off and remains off.

The event indicator is turned on while the fan is running.

Sample Ceramics Programs

Program Number	Program Name	Seg 1 Ramp Rate °C/hr	Seg 1 Soak Temp °C	Seg 1 Soak Time hr:mn	Seg 2 Ramp Rate °C/hr	Seg 2 Soak Temp °C	Seg 2 Soak Time hr:mn	Seg 3 Ramp Rate °C/hr
1	Slow Bisque	60	600	00:00	FULL	1000	00:00	END
2	Normal Bisque	100	600	00:00	FULL	1000	00:00	END
3	High Bisque	100	600	00:00	FULL	1140	00:00	END
4	Brush-on Earthenware Glaze 1000°C (Cone 6)	100	300	00:00	FULL	1000	00:00	END
5	Standard Earthenware Glaze 1100°C	100	300	00:00	FULL	1100	00:00	END
6	Earthenware High Temperature Glaze 1140°C	100	300	00:00	FULL	1140	00:00	END
7	Mid-Range Stoneware Glaze 1200°C	100	300	00:00	FULL	1200	00:00	END
8	Standard Stoneware Glaze 1260°C (see note)	100	300	00:00	FULL	1235	00:00	END
9	Onglaze 780°C	100	400	00:00	FULL	780	00:00	END
10	Lustre 750°C	100	400	00:00	FULL	750	00:00	END

Note

It has been found that a kiln controller will give greater heat work as the temperature increases. Therefore to achieve a stoneware firing of cone 8-9 we suggest setting the final soak temperature to 1235°C. A slight adjustment can then be made after the first firing. It should be remembered that kiln controllers are indicators of temperature and the effects of faster or slower firings may cause extreme variations in the end result. This is known within ceramics as ~~heatwork~~ heatwork. Cones are measures of heatwork and it is strongly recommended that cones are always used in conjunction with a kiln controller to appreciate the differences between heatwork and temperature indicated by the controller. Stoneware firings will also demonstrate the greatest potential differences between heatwork and indicated temperature.

Sample Glass Programs

The ST535 is provided pre-programmed with the glass firing programs below. These programs may be modified as required.

Program No.	Program Description	Seg 1 Ramp Rate °C/hr	Seg 1 Soak Temp °C	Seg 1 Soak Time hr:mn	Seg 2 Ramp Rate °C/hr	Seg 2 Soak Temp °C	Seg 2 Soak Time hr:mn	Seg 3 Ramp Rate °C/hr	Seg 3 Soak Temp °C	Seg 3 Soak Time hr:mn	Seg 4 Ramp Rate °C/hr	Seg 4 Soak Temp °C	Seg 4 Soak Time hr:mn	Seg 5 Ramp Rate °C/hr
1	4-6mm Float Glass Fuse	150	538	00:10	FULL	840	00:20	FULL	538	00:45	182	427	00:15	END
2	4-6mm Float Glass Slump	538	538	00:00	FULL	824	00:20	FULL	538	00:15	182	427	00:00	END
3	6mm Bullseyei Fuse	222	677	00:30	333	795	00:10	FULL	482	01:00	83	371	00:01	END
4	6mm Bullseyei Slump	167	640	00:10	FULL	482	01:00	56	371	00:01	END	-	-	-
5	6mm Spectrum System 96i Fuse	200	500	00:00	FULL	804	00:12	FULL	540	00:40	150	510	00:20	END
6	6mm Spectrum System 96i Slump	155	704	00:20	FULL	540	01:30	FULL	510	00:10	26	371	00:00	END
7	Bottle Firing Cycle	170	510	00:00	250	780	00:10	FULL	510	01:00	70	400	00:30	END
8	Low Stain	200	570	00:10	FULL	516	00:30	100	300	00:00	END	-	-	-
9	High Stain	200	665	00:10	FULL	550	00:20	FULL	516	00:30	100	300	00:00	END